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EVALUATION OF WEBSITES OF IT COMPANIES FROM THE PERSPECTIVE OF IT BEGINNERS

ЕВАЛУАЦИЈА ВЕБ САЈТОВА IT КОМПАНИЈА ИЗ ПЕРСПЕКТИВЕ IT ПОЧЕТНИКА

Branislav Ivanov[1]
University of Belgrade, Technical faculty in Bor

Milena Jevtić
University of Belgrade, Technical faculty in Bor

Dragiša Stanujkić
University of Belgrade, Technical faculty in Bor

Darjan Karabašević
University Business Academy in Novi Sad, Faculty of Applied Management, Economics and Finance

Florentin Smarandache
University of New Mexico, Department of Mathematics

Abstract: *The Internet has brought almost limitless possibilities for the promotion of services and products and thereby caused a significant change in the world. It also allowed beginners to get more important information about their future jobs. Based on this idea, the research and writing of this work began. In this paper, we investigate how much IT companies' websites provide information on company products, used technology and relationships with employees. The paper presents a multicriteria model for evaluating IT companies' websites from the point of view of young IT experts.*

[1] bivanov@tfbor.bg.ac.rs

Key words: *Website analysis, Single valued neutrosophic set, Multiple criteria evaluation.*

Сажетак**:** *Интернет је донео скоро неограничене могућности за промоцију услуга и производа и тиме изазвао значајне промене у свету. Такође је омогућио и почетницима да добију значајне информације о њиховим будућим пословима. Засновано на овој идеји, започело је истраживање и писање овог рада. У овоом раду, истражује се колико веб сајтови IT компанија пружају информације о компанијским производима, коришћеној технологији и односима са запосленима. Рад представља вишекритеријумски модел за евалуацију веб сајтова IT компанија из перспективе младих IT експерата.*

Кључне речи: *Анализа веб сајта, Single valued neutrosophic set, вишекритеријумска евалуација.*

1. INTRODUCTION

The website can help you in gaining information about the company, products and services. However, the existence of a website does not automatically provide a competitive advantage. So, there is one important question: How much website actually meets the requirements of its users and how to measure its quality?

In the literature, numerous studies have been devoted to the evaluation of web site quality. Boyd Collins developed the first formal approach to the evaluation of websites in late 1995. His model, intended for librarians, has been based on six criteria, developed by combining evaluation criteria for printed media, and considering what was relevant for websites (Merwe & Bekker, 2003). The model contains the following criteria: contents, authority, organizations, searchability, graphic design and innovation use.

Studies that are intended for the identification of key evaluation criteria, and / or their significances, are still actual. For example, Dumitrache (2010) gives an overview of criteria used for evaluation of e-Commerce sites in Romania, during the period 2006 and 2009. As very important criteria it defines Response Time, Navigability, Personalization, Tele-presence and Security. Davidaviciene and Tolvaisas (2011) identify the list of criterions for quality evaluation of e-Commerce website. They also provide a comprehensive overview of the criteria that have been recently proposed by different authors. In accordance with (Davidaviciene & Tolvaisas, 2011) criteria: Easy to use, Navigation, Security assurance, Help (real time) and Design have been discussed by numerous authors, such as (Loiacono *et al*., 2007; Parasuraman *et al*., 2007; Cao *et al*., 2005).

Compared to different types of e-commerce, the IT companies have its own peculiarities. Therefore, for the evaluation of IT companies' websites, we must use the appropriate set of criteria, and their significances.

The Internet has also brought significant opportunities for many less known IT companies.

In many countries, the development IT industry is often mentioned as one of the priority directions of development. A similar situation exists in Serbia, which has a number of attractive but also almost unknown IT companies.

After selecting certain IT companies, we probably want to learn more about them. Here, some questions arise: How much website of these IT companies provide the necessary information? To what extent IT companies use the benefits that the Internet provides? What information is provided to interested young IT experts?

The answer to the above questions we get with measuring the quality of websites of some IT companies that are located in Serbia.

Therefore, the rest of the paper is organized as follows: In the second section of the paper, some basic definitions related to the SVNS are given. In the third section of the paper, is proposed the criteria for evaluating websites from the standpoint of the new it professionals. In the fourth section is proposed the procedure for evaluating websites based on the use of adapted SWARA method and SVNS. In the fifth section, the proposed model has been applied to the evaluation of five IT companies that are in Serbia. At the end of the paper, the conclusions are presented.

2. SINGLE VALUED NEUTROSOPHIC SET AND NUMBERS

Definition. *Single valued neutrosophic set (SVNS)*. Let X be the universe of discourse (Wang *et al*., 2010). The SVNS A over X is an object having the form

$$A = \{x < T_A(x), I_A(x), F_A(x) > \mid x \in X\}, \quad (1)$$

where $T_A(x)$, $I_A(x)$ and $F_A(x)$ are the truth-membership function, the intermediacy-membership function and the falsity-membership function, respectively, $T_A, I_A, F_A : X \rightarrow [^-0,1^+]$ and $^-0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3^+$.

Definition. *Single valued neutrosophic number*. For the SVNS A in X the triple $< t_A, i_A, f_A >$ is called the single valued neutrosophic number (SVNN) (Smarandache, 1999).

Definition. *Basic operations on SVNNs*. Let $x_1 =< t_1, i_1, f_1 >$ and $x_2 =< t_2, i_2, f_2 >$ be two SVNNs, then additive and multiplication operations are defined as follows (Smarandache, 1998):

$$x_1 + x_2 =< t_1 + t_2 - t_1 t_2, i_1 i_2, f_1 f_2 >, \quad (2)$$

$$x_1 \cdot x_2 =< t_1 t_2, i_1 + i_2 - i_1 i_2, f_1 + f_2 - f_1 f_2 >. \quad (3)$$

Definition. *Scalar multiplication*. Let $x =< t_x, i_x, f_x >$ be a SVNN and $\lambda > 0$, then scalar multiplication is defined as follows (Smarandache, 1998):

$$\lambda x_1 =< 1 - (1 - t_1)^{\lambda}, i_1^{\lambda}, f_1^{\lambda} >. \quad (4)$$

Definition. *Power*. Let $x =< t_x, i_x, f_x >$ be a SVNN and $\lambda > 0$, then power is defined as follows:

$$x_1^{\lambda} =< t_1^{\lambda}, i_1^{\lambda}, 1 - (1 - f_1)^{\lambda} >. \quad (5)$$

Definition. *Score function*. Let $x =< t_x, i_x, f_x >$ be a SVNN, then the score function s_x of x can be as follows (Smarandache, 1998):

$$s_x = (1 + t_x - 2i_x - f_x)/2, \quad (6)$$

where $s_x \in [-1, 1]$.

Definition. *Single Valued Neutrosophic Weighted Average Operator*. Let $A_j =< t_j, i_j, f_j >$ be a collection of SVNSs and $W = (w_1, w_2, ..., w_n)^T$ is an associated weighting vector. Then, the Single Valued Neutrosophic Weighted Average (SVNWA) operator of A_j is as follows (Sahin, 2014):

$$SVNWA(A_1, A_2, ..., A_n) = \sum_{j=1}^{n} w_j A_j = \left(1 - \prod_{j=1}^{n} (1 - t_j)^{w_j}, \prod_{j=1}^{n} (i_j)^{w_j}, \prod_{j=1}^{n} (f_j)^{w_j}, \right), \quad (7)$$

where w_j is the element *j* of the weighting vector, $w_j \in [0,1]$ and $\sum_{j=1}^{n} w_j = 1$.

3. THE CRITERIA FOR EVALUATING WEBSITES FROM THE STANDPOINT OF THE NEW IT PROFESSIONALS

In the literature, numerous studies have been devoted to the evaluation of website quality. As a result, a number of criteria have been proposed for the evaluation of websites.

However, it should be taken into account that these studies were designed for the evaluation of different types of websites.

Therefore, in this case, a set of criteria that realistically reflects the goals of the IT beginners is selected. Due to the use of SVNN, a set of the evaluation criteria that containing a smaller number of criteria more complex was selected, as follows:

- C_1 - About Us,
- C_2 - Products and Services,
- C_3 - Technologies,
- C_4 - Carrier and benefits,

where**:**

- the criterion C_1 includes general information about a company that can serve to assess its relevance in the IT industry;
- the criterion C_2 more precisely defines the scope of the company's business; and
- criteria C_3 and C_4 indicates IT technologies that used in a company, as well as the possibility of advancement, which can be very important for new IT beginners.

4. THE PROCEDURE FOR EVALUATING WEBSITES BASED ON THE USE OF ADAPTED SWARA METHOD AND SVNS

In each multiple criteria evaluation process, the following three important activities could be identified:

- determining the importance of the evaluation criteria,
- evaluation, where the alternatives are evaluated in relation to the selected set of evaluation criteria, and
- aggregation and ranking alternatives.

In this approach an adaptation of the SWARA method is accepted for determining criteria weights. The SWARA method is proposed by Keršuliene *et al*. (2010), and this method can be considered as efficient and easy to use.

Therefore, this method is used to solve a number of decision-making problems. Unfortunately, the computational procedure of the SWARA method is based on the usage of an ordered list of evaluation criteria, presorted according to their expected significances, which can be a real limitation when it is necessary to collect the real attitudes of in advice unprepared respondents. Therefore, Stanujkic *et al*. (2017) proposed an extension of the SWARA method that does not require the use of a pre-sorted list of evaluation criteria, on which basis the weight of the criteria are determined in this approach.

However, the use of a large number of criteria can lead to forming a more complex MCDM models that could be less practical for the use in the cases when researches are based on gathering real attitudes of in-advice unprepared respondents. Therefore, this approach is based on the use of a smaller number of criteria that are evaluated using SVNN.

Finally, for the aggregation phase, a procedure based on the application of the SVNWA operator and the Score function is selected.

5. A NUMERICAL ILLUSTRATION

In order to explain the proposed approach in detail, below is considered an example of evaluation of the websites of five IT companies'.

In the conducted research, the evaluation of the websites of the following IT companies was carried out:

- **Comtrade**, available at: https://www.comtrade.com/;
- **Levi Nine**, available at: https://www.levi9.com/;
- **NIRI IC**, available at: www.niri-ic.com/;
- **AB Soft**, available at: www.absoft.rs/; and
- **Informatika AD**, available at: www.informatika.com/.

It should be stated here that the aim of this article is not to promote any of the above listed companies, because of which the order of the alternatives in the presented example does not correspond to the order of the above companies.

The responses obtained from the first of three considered respondents, and weights of criteria, obtained by using extended SWARA method, are encountered in Table 1.

The attitudes obtained from the three examinees, as well as the appropriate weights and group criteria weights, are presented in Table 2 as well.

Table 1. The responses and weights of the criteria obtained from the first of three evaluated respondents

Criteria		s_j	k_j	q_j	w_j
C_1	About Us		1	1	0.22
C_2	Products and Services	0.90	1.10	0.91	0.20
C_3	Technologies	1.20	0.80	1.14	0.25
C_4	Carrier and benefits	0.60	1.40	0.81	0.18
			∑	5.27	1.00

Table 2. The attitudes and weights obtained from the three examinees

	E_1		E_2		E_3		
	s_j	w_j	s_j	w_j	s_j	w_j	w_j
C_1		0.19		0.05		0.19	0.14
C_2	1.20	0.24	1.80	0.27	1.20	0.23	0.25
C_3	1.15	0.28	0.80	0.23	1.10	0.26	0.25
C_4	1.05	0.29	1.50	0.45	1.20	0.32	0.36

The following are the responses obtained from the three examinees regarding the evaluation of the websites.

Table 3. The ratings obtained from the first of the three examinees

	C_1	C_2	C_3	C_4
A_1	<0.5,0,0.2>	<0.7,0,0>	<0.7,0,0>	<0.8,0,0>
A_2	<0.7,0,0.5>	<0.8,0,0>	<0.9,0,0>	<0.9,0,0>
A_3	<0.15,0,0.2>	<0.3,0,0.15>	<0.2,0,0.3>	<0.1,0,0.4>
A_4	<0.25,0,0.3>	<0.2,0,0>	<0.15, 0,0.2>	<0.05,0,0.3>
A_5	<0.2,0,0.4>	<0.4,0,0>	<0.1, 0, 0.5>	<0.05,0,0.2>

Table 4. The ratings obtained from the second of the three examinees

	C_1	C_2	C_3	C_4
A_1	<0.8, 0, 0.2>	<0.9, 0, 0>	<0.8, 0, 0>	<0.8, 0, 0>
A_2	<0.5, 0, 0.6>	<0.8, 0, 0>	<0.6, 0, 0>	<0.7, 0, 0>
A_3	<0.1, 0, 0.8>	<0.3, 0, 0>	<0.35, 0,0.8>	<0.2, 0, 0>
A_4	<0.2, 0, 0.6>	<0.2, 0, 0>	<0.3, 0, 0>	<0.1, 0, 0>
A_5	<0.6, 0, 0.3>	<0.1, 0, 0.9>	<0.2, 0, 0>	<0.1, 0, 0>

Table 5. The ratings obtained from the third of the three examinees

	C_1	C_2	C_3	C_4
A_1	<1, 0, 0.1>	<0.5, 0, 0>	<0.9, 0, 0.1>	<0.8,0.1,0.1>
A_2	<0.5,0.1,0.3>	<0.4, 0, 0>	<1, 0, 0>	<0.8,0.1,0.1>
A_3	<0.4, 0, 0>	<0.4, 0, 0.1>	<0.4, 0.1, 1>	<0.4,0.3,0.2>
A_4	<0.2,0.2,0.2>	<0.1, 0, 0>	<0.3,0.3,0.1>	<0.1, 0, 0.4>
A_5	<0.5,0.2,0.1>	<0.1,0.2,0.1>	<0, 0.3, 0.5>	<0.1, 0, 0.4>

The group ratings and overall ratings, shown in Table 6 and Table 7, are obtained by using SVNWA operator, or more precisely by using Eq. (7).

Table 6. The group ratings

	C_1	C_2	C_3	C_4
A_1	<1,0, 0.16>	<0.75, 0, 0>	<0.82, 0, 0>	<0.8, 0, 0>
A_2	<0.58,0,0.45>	<0.71, 0, 0>	<1, 0, 0>	<0.82, 0, 0>
A_3	<0.23,0,0.03>	<0.34,0,0.01>	<0.32,0,0.62>	<0.24,0,0.02>
A_4	<0.22,0,0.33>	<0.17, 0, 0>	<0.25,0,0.01>	<0.08,0,0.02>
A_5	<0.46,0,0.23>	<0.21,0,0.02>	<0.1,0,0.03>	<0.08,0,0.02>

The ranking order of considered alternatives, obtained based on the values of the score function, calculated by using Eq. (6), is also presented in Table 7.

Table 7. The overall ratings

	Overall ratings	S_i	Rank
A_1	<1, 0, 0>	0.9992	2
A_2	<1, 0, 0>	0.9993	1
A_3	<0.29, 0, 0.04>	0.6207	3
A_4	<0.17, 0,0 .01>	0.5807	4
A_5	<0.19, 0, 0.03>	0.5767	5

As it can be concluded on the basis of the data presented in Table 7, the most promising company from the perspective of an IT beginner is the company labelled as A_2, which is somewhat more promising than a company designated as A_1.

6. CONCLUSION

This paper proposes a simple but also effective framework, which can be used for measuring the quality of IT companies' websites from the perspective of IT beginners.

The proposed procedure for evaluating websites based on the use of adapted SWARA method and SVNS has been successfully applied to the evaluation of five IT companies.

Using this procedure, the managers of IT companies, can evaluate their and competing websites and compare them. This would continually influence the improvement of the quality of the websites and thus make it easier for youngsters to get to the desired information about the IT company.

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